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implications for knowledge and technology transfer

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Implications for knowledge and technology transfer

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ABSTRACT:

Private sector R&D is largely concentrated in a few multinational companies (MNCs). The mobility of labor between these MNCs and the rest of the economy is therefore an important mechanism for the diffusion of knowledge and technology, but these flows are not without friction. This paper analyses in great detail the flow of labor between firms with specific emphasis on flows to and from R&D intensive MNCs. Using linked employer-employee data for Denmark, we match employees moving from R&D intensive MNCs to other employees switching jobs. We find that employees are more inclined to move between R&D intensive MNCs and their subsidiaries rather than between these firms and other firms in the economy. This is particularly true for high skill employees. Our results suggest that other domestic firms are to a larger extent kept out of the 'knowledge spillover' loop, which provide them with fewer opportunities to learn from the R&D intensive MNCs. In other words, R&D intensive MNCs and their subsidiaries form a kind of sub-labor market within the national labor market; employees exhibit higher mobility within this group of firms than between this group and the rest of the labor market.

JEL CODES: J21, F23, O32

KEYWORDS: Labor mobility, Multinational companies, Knowledge flows, R&D

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1. Introduction

Private sector R&D is concentrated in a few multinational companies (MNCs). In 2015, the top 2500 R&D firms worldwide invested more than 90 percent of the global business enterprise expenditure in R&D (Guevara et al. 2015). Top R&D investors thus play an important role in the creation of knowledge and technology in the economy. The integration of these firms in the broader economy is therefore important in order to create knowledge spillovers to the rest of the economy, through various mechanisms such as flows of employees from one firm to another.

Previous literature has investigated the role of labor flows as a mechanism for knowledge transfer from MNCs to non-MNC firms in the same country. For example, using data on Norwegian manufacturing firms for the period 1990-2000, Balsvik (2011) investigates the productivity spillovers that arise when employees leave MNCs to work at non-MNCs. Relatedly, Poole (2013) presents evidence of positive spillovers from MNCs to non-MNCs, which is associated with worker mobility, in the context of Brazil. Falck (2016) contains an exploratory analysis of labor mobility patterns in Sweden, framed in terms of evidence of opportunities for spillovers from MNCs to domestic non-MNCs.

Related, Stoyanov and Zubanov (2014) analyze Danish employer-employee data to investigate the productivity spillovers that arise when employees are hired from technologically-superior firms, and in particular they focus on the distribution (between the firm and the focal employee) of the financial gains that are generated by these spillovers. Kaiser et al. (2015) demonstrate that firms who hire workers from patent-active firms increase their own patent activity. Recently, Csáfordi et al. (2020) finds that labor mobility increases productivity whenever workers move from high-productivity firms to low-productivity firms.

Labor mobility is a key mechanism in interfirm knowledge transfer (Song et al. 2003; Lenzi 2010; Rahko 2017). When labor moves from one firm to another it transfers formal knowledge as well as tacit skills (Almeida and Kogut 1999). Therefore, hiring can be used by firms to gain access to new knowledge and new skills (Palomeras and Melero 2010). Similarly, studies of labor mobility from MNCs closing down have shown that the former MNC employees constitute a desirable pool of knowledge and are in high demand among local firms (Sofka et al. 2014). Interfirm knowledge transfers are not only created directly by the mobility of labor, but also by the informal networks between firms created by labor mobility (Lengyel and Eriksson 2017).

It is thus important that labor flows from R&D intensive MNCs to the rest of the economy, for the diffusion of new knowledge and the creation of networks among firms. But for labor mobility to act as a mechanism for knowledge transfer, two conditions need to be fulfilled. First, people need to move from the R&D intensive MNCs to other domestic firms. Second, knowledge has to be integrated into the receiving firm. The literature on absorptive capacity and learning by hiring has addressed the question of knowledge integration in great detail. The extent to which labor mobility transfers

knowledge is a function of how proximate the two organizations are in terms of knowledge distance (Palomeras and Melero 2010), and the receiving firm's absorptive capacity (Cohen and Levinthal 1990). These works assume that mobility has occurred, but there are several factors that constrain the mobility of workers between organizations. The specific human capital places one constraint but the fact that R&D intensive MNC are among the most attractive employers including paying high wages (Hijzen and Swaim 2008) is an additional constraining factor that makes it less attractive for workers to move to domestic (non-R&D intensive) firms.

In this paper, we analyse the antecedents of labor mobility with a specific emphasis on labor mobility between MNCs and the rest of the economy, and on the consequences of moving between firms on employees' wages. To do this, we construct a unique dataset by merging two datasets. The first dataset is taken from the European Commission's EU Industrial R&D Investment Scoreboard, which contains economic and financial data for the top corporate investors worldwide as well as data on the corporate structure of the firms allowing us to identify subsidiaries. The other dataset is constructed from registry data for the entire Danish economy containing detailed data on all firms, workplaces, employment relations and employees for all years from 1980 until 2014. Each individual can be tracked over time allowing us to analyse the antecedents of labor mobility.

Our results suggest that, to some degree, there is segmentation in the labor market. Labor flows from R&D intensive MNCs to the rest of the economy are relatively limited. Employees at R&D intensive MNCs are less likely to take subsequent jobs at firms that are not R&D intensive MNCs and are more likely to take subsequent jobs at R&D intensive MNCs. The probability of employees moving from domestic MNCs to other domestic MNCs is particularly high. Moreover, we also observe that jobs at R&D intensive MNCs offer a 5 percent wage premium. This could partly explain why labor mobility is mainly taking place among MNCs.

This paper makes several contributions to the literature. First, we focus on the labor flows of the top R&D investors. Our focus on R&D intensive MNCs is an interesting addition, because previous work has suggested that the labor mobility of high-skill workers (presumably more common in top R&D investors) is associated with especially high spillovers (Poole 2013; Agarwal et al. 2016). Our focus on R&D intensive MNCs can be expected to be particularly relevant for policy-makers, whose interest in promoting R&D investments is linked to the understanding of the behaviour of R&D intensive firms. Second, earlier studies have suggested that there is a need to consider organizational types and ownership structure when studying worker mobility (Wright et al. 2018). Thus instead of focusing only on MNCs vs non-MNCs (e.g. Balsvik 2011), we also distinguish between foreign and domestic MNCs, where domestic MNCs are distinguished from other domestic firms. We therefore identify three categories of firms: *i)* foreign MNCs, having the headquarter located outside Denmark; *ii)* domestic MNCs, headquartered in Denmark, and; *iii)* other domestic firms. This is important because it allows us

to investigate whether domestic MNCs act as a bridge in the labor market between foreign MNCs and the other domestic firms. Third, we complement previous studies with evidence on the effects on wages, where previous work has generally focused on productivity. Wages are an important component of labor market transitions (Campbell et al. 2012; Agarwal et al. 2016; Haltiwanger et al. 2018b), and we are able to overcome data limitations that faced previous work in the area to present new results. Fourth, while previous literature investigating spillovers from MNCs to non-MNCs has focused on other countries, we provide new evidence from Denmark. This is a small, open and well-developed economy with a reasonably egalitarian wage structure, and where one could expect a limited role for multinational enterprises in shaping the within-country inequalities discussed by Narula and van der Straaten, (2019).

This paper is structured as follows. In section 2 we discuss previous research and derive our research questions. In section 3 we describe the sources of data, while the data are described in section 4. Section 5 contains the analyses and results, which are followed by a robustness analysis in section 6. The conclusions are presented in section 7.

2. MNCs and Knowledge Transfer through Labor Mobility

Knowledge transfer from MNCs can happen through more or less formalized channels (Crespo and Fontoura 2007; Falck 2016; Di Ubaldo et al. 2018). The location of MNCs in a region can generate demonstration effects, as domestic firms imitate MNCs. Knowledge spillovers may arise if domestic firms can benefit from operating in the same markets, ecosystems, and supply chains of MNCs. For example, the demand arising from MNCs could provide domestic firms with opportunities to invest in upgrading in order to provide high-quality inputs for next-generation products. Domestic firms could also benefit from proximity to MNCs by buying their products and services and benefiting from the knowledge embodied in these. However, these spillover mechanisms may not be effective if MNCs are secretive in their business processes, and if MNCs are vertically integrated, or if MNCs source from abroad.

A more formalized channel for knowledge transfer is labor mobility (Almeida and Kogut 1999; Song et al. 2003; Audretsch and Keilbach 2005; Görg and Strobl 2005; Lenzi 2010). Individuals who work at R&D intensive MNCs may accumulate valuable tacit knowledge, enhance their professional skills and practice efficient routines, such that they may be able to take this valuable knowledge with them if they start new jobs in other firms. In this way, best-practice is diffused and hiring firms enjoy productivity effects (Balsvik 2011; Csáfori et al. 2018).

MNC employees constitute a desirable pool of knowledge and are in high demand among local firms (Sofka et al. 2014). Interfirm knowledge transfers are not only created directly by the mobility of labor, but also by the informal networks between firms created by labor mobility (Lengyel and Eriksson 2017). In studies on labor mobility of R&D workers in Denmark, Kaiser et al (2015; 2018) find that mobility of R&D workers between firms increases the total firm level inventions if one of the two firms involved

in the transfer was patent active in the past and have an internal research culture. Big R&D multinationals are companies with a proven internal research culture, given they are highly involved in scientific publication activities (Camerani et al 2018), which makes them an appropriate environment for newly-hired R&D workers to thrive. Furthermore, MNCs with relatively large R&D investments are also highly patenting firms (Dernis et al 2019).

Labor mobility is thus generally seen as positive for the receiving firm, and while it may have adverse effects for the source firm, there is a general consensus that the aggregate effect is positive so that policy should favor labor mobility (Campbell et al. 2012;Agarwal et al. 2016). Many studies consider mobility across companies as frictionless and focus on the potential spillovers deriving from labor mobility thereby neglecting the constraints on labor mobility. So, if these firms form a separate labor market in the host economy, this limits the effectiveness of the knowledge transfer mechanism via labor mobility and the creation of networks among firms.

The literature on labor flow networks address these frictions explicitly (Guerrero and Axtell 2013; Haltiwanger et al. 2018a; Sorkin 2018). In the labor flow networks model, employers are hierarchically ranked by employees according to the desirability of the jobs they offer. Higher ranked employers offer jobs with a better combination of pecuniary and non-pecuniary rewards. Employees do not move randomly between jobs, but rather try to find a job at a higher-ranked employer. Jobs at high-ranking firms are more competitive, entailing a selection effect whereby the most skilled employees work at top tier firms. Firms are thus heterogeneous and employees seek to 'move up the job ladder' to better jobs (Haltiwanger et al. 2018a). Analysis of moves from employer to employer can reveal the preferences of employees for different firms (Guerrero and Axtell 2013; Sorkin 2018).

Labor mobility plays a role in productivity enhancing re-allocation of workers (Haltiwanger et al. 2018a), which also explains that a substantial amount of wage dispersion exists between firms (Davis and Haltiwanger 1991); at least to the extent at which the high productivity dispersion matches that of wages. Previous works (e.g. Oi and Idson 1999) show that firm size contributes in explaining wage dispersion; larger firms, where the management can afford paying higher (and more heterogeneous) wages, are able to provide wage-premiums. This would influence the choices of employees when searching for a new job. Indeed, since an important share of lifetime wage growth is associated to firm-specific experience and interfirm mobility (Mincer and Jovanovic 1981), holding everything else equal, workers will try to move to companies able to pay a higher premium. An emerging stream of literature investigates wage growth as individuals move from one category of employer to another (e.g. Haltiwanger et al. 2018b), or the pecuniary and non-pecuniary (intrinsic) factors motivating and hampering mobility (Agarwal et al. 2016), although to our knowledge there is no such evidence for labor flows into and out of R&D investing multinationals.

Sorkin (2018, p.1343) finds that about 20% of the variation in earnings is due to a firm-specific effect, suggesting that some firms pay higher wages, in general, than others. R&D intensive MNCs can therefore be expected to pay wage premiums to their employees to guarantee to be able to attract (at least part of) the most talented workers. Their higher capital to worker ratio, advanced technological capabilities, exposure to MNC rules, routines, and corporate culture, as well as the accumulation of tacit knowledge in a challenging working environment may eventually enhance their workers' capacities, and compensate for the cases where an employee is less productive (or skilled) than expected.

Overall, we assume that MNCs represent top ranked employers. Therefore, we postulate that, all else equal, workers prefer to be employed at an R&D intensive MNC. The *"headquarter effect"* will enhance this for domestic MNCs, due to allocation of decision-making rights (Ciabuschi et al. 2010) as well as non-pecuniary benefits of being employed at a national champion. Consequently, we assume that domestic MNCs are ranked higher than foreign MNCs. Therefore, the prediction from the labor flow networks theory is that individuals working at these firms are highly skilled. Many workers will be happy with their jobs and will not move. For those that do move, they will try to stay within the elite club of firms.

The discussion above, opens up for the following research question: *What factors hinder and promote labor mobility between R&D intensive MNCs and other firms in the economy?* To address this question, we will investigate whether the domestic and foreign R&D intensive MNCs draw on different labor markets compared to other domestic firms, and whether workers in the different labor markets are rewarded differently.

3. Data

In addressing this overall research question, we investigate labor mobility patterns in Denmark, and we take as a point of departure the whole of private sector employees in Denmark in 2012-2014. This information is retrieved from the Danish linked employer-employee database (IDA), which provides us with detailed information on all individuals and firms in the Danish economy. IDA data are available from 1980 onwards, but we restrict the analysis to the period 2012-2014 as data for the corporate structure of R&D intensive multinationals are available from 2012, and the final year of IDA was 2014 at the time of conducting the analysis. IDA's universal and longitudinal character allows us to identify the career trajectory for all workers in the Danish economy, which includes change of employers. To measure job mobility, we identify the employment relation in the following calendar year. In our sample, we exclude all individuals who move out of employment, i.e. become unemployed, emigrate, start an education, or otherwise exit the labor market.

To assure that mobility events are not driven by firm exit, we exclude mobility events following the closure of a firm. Based on this criterion, we have a total sample of just above 4.4 million workers, averaging around 1.47 million workers for each of the three years considered. This sample decreases

further as we set additional employment restrictions for the individual workers. First, workers are required to have a full-time contract in both years. Second, we only include workers who have been employed for at least one year. Third, in case a worker changes job, s/he must have been employed at the new employer for at least 90 days. These restrictions lower the sample to 2.5 million observations.[1]

To identify R&D intensive MNCs, we rely on the "EU Industrial R&D Investment Scoreboard." Given the data restrictions (i.e. 2012 onwards, as mentioned above) for the corporate structure data, to which we merge the 'Scoreboard data', we focus on the years 2012-2015. The 'Scoreboard' dataset is built from the annual reports and provides a ranking of the world's top 2500 corporate R&D investors.[2] For each year, we identify Danish MNCs that are present in the Scoreboard, Danish subsidiaries of these MNCs, and subsidiaries in Denmark of foreign MNCs.[3] Collectively, these three groups are referred to as Scoreboard (SB) firms. When necessary we distinguish between the three groups. Firms in the rest of the private sectors are referred to as non-SB firms. Based on this information, we identify 1191 unique SB firms (204 Danish SB firms and their subsidiaries, and 1021 foreign SB firm subsidiaries).[4] Using the unique firm identifiers, SB firms and Danish subsidiaries are matched with the employment register to identify their employees.

The registry data contain data on employees and firms, while it is the Scoreboard data that allow us to group some firms into conglomerates. The structure of the data is illustrated in Figure 1. This entails that only conglomerates where the parent company is in the Scoreboard are identified, and firms referred to as non-Scoreboard firms may very well be part of a conglomerate which is not included in the Scoreboard data. Any potential conglomerates that are not listed on the Scoreboard would correspond to cases of conglomerates with relatively low R&D investments.

INSERT FIGURE 1 AROUND HERE

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4. Scoreboard Firms' R&D Spending and Innovation Performance

Firms appearing in the EU Industrial R&D Investment Scoreboard account for a significant share of economic activity in Denmark measured by employment, innovation activity, and R&D expenditures. Therefore, these could be important sources of knowledge transfer. However, there are also notable

[1] In our analysis, we also run regression analysis on the unrestricted sample and on a sample only including R&D workers, where R&D workers are defined according to Kaiser et al. (2018), i.e. individuals that have a college degree in Science, Technology, Mathematics and Medicine (STEMM) and have an occupation with ISCO level 2 or 3. The findings are robust and details are available upon request.

[2] The full scoreboard is freely accessible at the webpage of the JRC-B3-IRITEC: http://iri.jrc.ec.europa.eu/home

[3] Information on subsidiaries is obtained directly from Bureau van Dijk using the corporate structure of SB firms in the period 2012-2015. Overall, Scoreboard firms are linked to about 600,000 subsidiaries.

[4] The two numbers do not add up to 1225 as some subsidiaries change parent company from Danish SB to Foreign SB.

differences between the domestic firms listed on the Scoreboard and the subsidiaries of foreign SB firms, where the domestic SB firms are the largest and most innovative. The subsidiaries of foreign SB firms are still larger and more innovative compared to non-SB firms.

Table 1 shows the innovation activities of subsidiaries of SB firms compared to non-SB firms in Denmark. The table is created by merging our data with the 2013 Community Innovation Survey for Denmark.

SB subsidiaries are more innovative than other firms, but domestic subsidiaries are more innovative than foreign ones. A potential reason might be the overrepresentation of wholesale activities among foreign subsidiaries. Among the domestic subsidiaries, 61% have introduced a product and/or service innovation, while the same holds true for 39% of the foreign SB subsidiaries and for 24% of other private firms (non-SB firms). Differences among the three groups in the other types of innovation are smaller, but the ranking is the same: domestic SB firms and their subsidiaries are the most innovative while non-SB firms are the least innovative. The reason why the difference is stronger when looking at product innovation may be related to the type of activities that the various firms undertake in Denmark.

INSERT TABLE 1 AROUND HERE

Table 1 shows that the average non-SB firm invests 0.388 million euros in R&D, while foreign and domestic subsidiaries invest 2.3 and 36 million euros, respectively. While SB subsidiaries account for 12% of total employment, they account for almost 2/3 of private sector R&D in Denmark. The lion's share of these expenditures is represented by subsidiaries of domestic SB firms. Among non-SB firms, less than a quarter have R&D expenditures at all (the 75^{th} percentile is zero) while less than half of foreign SB subsidiaries have R&D expenditures (the median is zero). Thus, domestic SB firms and their subsidiaries do not just spend more on R&D on average; they are also more likely to spend anything at all on R&D. The domestic SB firms and their subsidiaries also have the highest R&D intensity, with 27.9 million euros of R&D per 1000 FTE employment or 9.3 euros of R&D per million euros of sales.

By aggregating the R&D expenditures of the subsidiaries and comparing the result to the total international R&D expenditures of the SB firm as reported in the SB data, it is possible to calculate the share of total R&D located in Denmark. The R&D expenditures by foreign SB subsidiaries amounts to 0.5% of the total international SB firm R&D expenditures for foreign SB firms, while the corresponding value for domestic SB subsidiaries is 66%. This highlights that domestic subsidiaries include parent firms and that MNCs often have most of their R&D expenditures in their home country. However, it

must be kept in mind that foreign subsidiaries still spend much more than other private sector firms on R&D in Denmark.[5]

5. Analysis and Results

5.1 Variables

5.1.1 Dependent variables

The job mobility part of our analysis addresses two elements of our research question. First, we want to investigate mobility patterns of employees who work for SB firms compared to workers employed in non-SB firms. As mentioned earlier, we identify a mobility event when a worker changes employer. Second, besides identifying mobility, we distinguish between mobility to SB firms (which we disaggregate into Danish vs foreign SB firms), or to non-SB firms. The dependent variable is a categorical variable with three categories: *i)* the worker remains at the same employer; *ii)* the worker switches employer and the new employer is not a SB firm; *iii)* the worker switches employer and the new employer is a SB firm. The first category is the reference category. In the final model, the dependent variable has four categories as we distinguish between new jobs at foreign and domestic SB firms.

In addition to job mobility, we investigate wage growth following the job change. Wage levels are derived by identifying annual salaries obtained from a particular employer and the number of hours worked. This allows us to identify hourly wages, which is easily comparable across workers. The dependent variable "Wage growth" is measured as differences in the logarithm of hourly wage between t and t+1.

The analysis of wage growth employs an OLS model, while the analyses of mobility employ multinomial logistic models (Hilbe 2009). For the latter we construct a dependent variable that is exhaustive in terms of forms of mobility within Denmark. We are not able to track labor mobility crossing national borders, and we assume that the choice of migrating (or not) can be modelled independently from that of choosing different working environments within national borders. This assumption is the equivalent of the independence of irrelevant alternatives (IIA) assumption, but the IIA assumption is also tested with a Hausmann test. The multinomial logistic model produces conditional probabilities of the general form specified in equation 1.

$$\Pr(y_{it} = j|x_{it}) = \frac{\exp(x'_{it}\beta_j)}{\sum_{j=1}^{k}\exp(x'_{it}\beta_j)} \quad (1)$$

[5] The differences between the foreign SB subsidiaries and domestic SB firms and their subsidiaries cannot be attributed to the latter group including the 25 Danish SB firms themselves, as a large share of the SB firms appear very small in the registry data and are not covered by the FUI survey, cf. earlier. Instead, it indicates a corporate structure among SB firms where activities in the home country are separated into a number of distinct and legally independent firms, e.g. a large domestic SB firm may have a separate R&D subsidiary and not just a R&D department.

y_{it} is the dependent variable which, for model 1, indicates whether worker i in year t either: 1) remains at the same employer; 2) finds a new job at an SB firm or; 3) finds a new job elsewhere. These three alternatives are indexed by j and k is the total number of alternatives. x_{it} are the independent variables elaborated in the next section including a 1 for the intercept, and the β_j are the vectors of parameters to estimate. As $j = 1$ is the reference, $\beta_1 = 0$ and we report the estimates for the two vectors β_2 and β_3. Later multinomial logistic models will have more levels for the outcome variable, but they all follow the general structure of equation 1.

5.1.2 Independent variables

Employed at a Scoreboard firm. Based on the Scoreboard dataset, we create a dummy variable indicating whether a worker is employed at a SB firm, both considering mother companies and subsidiaries. Here we also make a distinction between Danish and foreign SB firms.

Gender and age. For all workers we have information on gender and create a dummy variable indicating if the worker is female. We have also information on the year of birth, which allows us to calculate the age of all workers in our sample.

Tenure and job experience. Tenure is a continuous variable that indicates the number of years a person has been employed at the (previous) employer. Job experience is a continuous variable that measures the total years that have passed since the first time we observe the person in the employment register. Because the register starts in 1980, we have no information on employment history prior this data.

Wage and skill levels. For wage level, we use the above-mentioned hourly wage rate for the work. As an indicator for skill level, we use the ISCO first-digit occupational categories (see Table 2). All workers are subsequently divided in three skill set categories: high, middling and low. We create a dummy variable for each worker corresponding to the respective skill category.

Region and industry. For regions, we identify the municipality in which a worker is employed. This municipality information is aggregated to the NUTS3 level; Denmark is separated in 12 NUTS3 level regions. We also control for industry by creating dummies for the two-digit NACE rev.2 industry codes.

INSERT TABLE 2 AROUND HERE

5.2 Descriptive statistics

Figure 2 shows the median wage for the eight occupational groups sub-divided into domestic SB, foreign SB and non-SB private sector firms. The median wage is lowest in non-SB firms for most occupation categories. The group with the highest median wage is managers of domestic SB firms, which is likely

to reflect a "home bias" and subsequent headquarter dominance in the upper echelon of the organization's workforce.

INSERT FIGURE 2 AROUND HERE

In Table 3, we present the descriptive statistics for the sample. Approximately 3 percent of all workers change job (move) in our sample, where about 2.7 percent move to a non-SB firm and 0.3 percent move to a SB firm. As mentioned before, 18 percent are employed at an SB firms, and this is divided roughly equally between Danish SB firms (and their subsidiaries) and foreign SB firms (through their subsidiaries). Since we concluded that the number of Danish SB and their subsidiaries are roughly 20 percent of all SB firms, we can conclude that Danish SB firms and their subsidiaries are much larger. The average growth in hourly wage equals roughly 3 percent. Approximately 31 percent of workers in our sample are female, and the average age is nearly 43 years. Average education is 14 years, which correspond to an upper secondary education or a short-cycle tertiary degree, and the average work experience is approximately 24 years. Workers earn on average 213 DKK per hour (28.5 EURO) and 40 percent are in an occupation category that is classified as high.

INSERT TABLE 3 AROUND HERE

In Table 4, we present the mobility patterns of workers in more detail. These patterns show that SB workers are less inclined to move compared to non-SB workers. However, when they move, they are more likely to move to other SB firms rather than to move to non-SB firms. This already foreshadows some of our results that the labor market for SB-workers is rather limited.

Table 4 shows that there are 230,971 employees in domestic SB firms; 98.7% of these do not move to another firm. Only 2606 of these will move to a non-SB firm, 276 will move to a foreign SB firm, and 124 will move to a different domestic SB firm. Regarding foreign SB firms, 97.5% of employees will remain within the firm. Among those that move, 790 will move to a different foreign SB firm, 652 will move to a domestic SB firm, and 4022 will move to a non-SB firm. Hence, while most SB employees do not change jobs, and many will move to jobs in other SB firms, nevertheless there is a non-negligible group of SB employees moving to non-SB firms.

INSERT TABLE 4 AROUND HERE

Table 5 presents the distribution of the different occupation and education levels. Based on the distribution of occupation codes, it can be observed that domestic subsidiaries employ a larger share of professionals and associated professionals, while foreign SB subsidiaries recruit a relative high share of clerical support workers. As for the differences in innovation activities (see Table 1), the differences in the distribution of occupations in Table 5 might reflect the difference in economic activities between domestic and foreign SB subsidiaries. In particular, it may reflect that a relatively large share of foreign SB subsidiaries is wholesalers. SB subsidiaries tend to hire more highly educated workers on average, but domestic SB subsidiaries clearly hire more educated workers than foreign SB subsidiaries.

INSERT TABLE 5 AROUND HERE

5.3 Econometric estimation and results: job mobility

5.3.1 Multinomial Logit estimations

To investigate the probability of labor mobility for these workers in greater detail, we apply a multinomial logit model.[6] These models are presented in Table 6. The results from Model 1 demonstrate that, when controlling for other factors, a worker in a SB firm or subsidiary is more likely to stay in a SB firm or subsidiary compared to moving to a non-SB firm. However, this worker is more likely to move to another SB firm or subsidiary when the opportunity arises. This provides evidence that labor markets function more like labor flow networks rather than labor market pools (Guerrero and Axtell 2013). Employees do not change jobs at random, but employees working at high-status firms (such as SB firms) are more likely to move from one SB firm to another. Furthermore, we also see some clear distinction in the human capital characteristics for those workers that are inclined to move to a SB firm or subsidiary. First, higher educated workers, those with more overall work-experience and high skilled occupations are more inclined to move to SB firms or subsidiaries. Less tenure in the previous workplace and age is negatively related to a move to a SB firm or subsidiary. Thus based on these results, SB firms and subsidiaries draw on workers that appear to be in different segments of the labor market.

INSERT TABLE 6 AROUND HERE

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[6] To test whether we violate the IIA assumption, we apply a Hausman test especially designed for multinomial logistic analysis with clustered data (Weesie, 2000). The Hausman test indicates that the IIA assumption is not violated, which means our specification is correct.

5.3.2 Coarsened Exact Matching

Since workers of SB firms are expected to be different from workers for non-SB firms, we have some concerns about the comparability of these workers. Consequently, we apply a matching technique to address this problem. More specifically, we use Coarsened Exact Matching (CEM) (Iacus et al. 2012). The CEM approach allows us to balance covariates between workers that are employed in SB firms or subsidiaries with workers in non-SB firms, neutralizing possible distortions deriving from different distributions of the covariates. Workers are placed in a finite set of bins based on individual-level characteristics. Based on this method, we create a new sample where SB employees that cannot be matched with non-SB employees (and vice versa) are removed from the sample. The variables used for matching are gender, age categories, education levels, and wage quartile. To deal with industry and regional variation, we also add our industry and region dummies to the matching equation.

Based on this procedure, we find a match for 94 percent of the SB employees and 70 percent of the non-SB workers, occupying a total of 74,241 strata. Implementing CEM reduces the final sample from 2,530,720 to 1,937,075 workers. In Table 2, we have included a column with descriptive statistics between these samples, and the descriptive statistics are rather similar (with the exception of the distribution between SB and non-SB workers). Running the multinomial analysis on this matched sample (Model 2) yields similar results.

In Model 3, the SB firms and subsidiaries are divided into domestic and foreign firms, to investigate whether there are differences in the mobility patterns of workers. This analysis shows that both forms of SB employees are more inclined to remain in the firm rather than to move to a non-SB firm, and that the likelihood to move is mainly explained by those employed by foreign SB subsidiary. In Model 4, we create an extra category in the dependent variable to measure the relation between the probability to move to a domestic or foreign SB firm or subsidiary. The findings demonstrate that employees in domestic SB firms and subsidiaries are more likely to move to a domestic SB firm or subsidiary, while employees in foreign SB subsidiaries are more likely to move to SB firms and subsidiaries in general, particular to other foreign SB subsidiaries. Thus, overall it shows that mobility is rather cliquish, meaning that SB employees limit their mobility pattern to within the population of SB firms and subsidiaries. In the appendix, we included an additional logit and multinomial logit, where moving to a non-SB firm is the benchmark. These models demonstrate that workers in SB firms are between 2 and 5 times more likely to move to another SB firm rather than moving to a non-SB firm.

5.3.3 Robustness analysis

We identify SB firms and their Danish subsidiaries. We have thus to acknowledge that the mobility we observe might take place between subsidiaries from the same parent company. This might particular be an issue since we observe much mobility between subsidiaries from Danish SB firms, while the Scoreboard only lists a limited number of Danish MNC's.

While mobility between subsidiaries of the same SB firm would still indicate a relatively closed labor market, one might argue that this is the main driver of the positive effect we observe in Table 6. Consequently, we run an additional analysis where we remove all mobility that is between the subsidiaries from the same parent firm. We would like to emphasize that we can only identify such mobility patterns among SB firms, as we cannot identify parent firms of non-SB firms.

Table 7, both Model 5 and Model 6, demonstrates that some of the positive effect is indeed explained by the fact that workers in subsidiaries of SB firms are more likely to move between subsidiaries of the SB firm. Consequently, the previous positive effect decreases in effect size, and workers in a domestic SB firm are just as likely to move to another SB firm as they are to stay. Nevertheless, since they are still less likely to move to a non-SB firm, it confirms our previous findings that labor market remain separated.

INSERT TABLE 7 AROUND HERE

5.4 Labor mobility and wage growth

Based on the theory section, the expectation is that we see more mobility between SB firms as well as higher mobility towards these firms from non-SB firms, because these new jobs offer attractive opportunities for career development and wage growth. However, alternative explanations are possible, for example employees might decide to stay in SB firms, despite having to accept lower wages, because of a non-pecuniary benefits (i.e. preferences for national champions or task content of the job, such as specializing in R&D) or because their skills are undervalued in alternative employment opportunities. We therefore investigate whether labor flows to SB firms are indeed associated with wage growth.

The results presented in Table 8 investigate the effect of job changes (move) on wage growth. The dependent variable “Wage growth” is measured as differences in the logarithm of wage. Model 7 in Table 8 shows the wage growth of the full sample. Model 8 measures wage growth in the CEM sample. Both models show that those employees moving to a SB firm or subsidiary experience higher wage growth. This wage growth premium is approximately 5 percent.

INSERT TABLE 8 AROUND HERE

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6. Conclusions

We analyzed job mobility and the associate wage premium for the universe of Danish firms. In particular, to investigate labor mobility as a possible channel for knowledge spillovers, we investigated the labor flows into and out of R&D intensive MNCs. To do so, we identified the top R&D investors

worldwide using the EU Industrial R&D Investment Scoreboard dataset (known as 'Scoreboard' firms) active in Denmark - whether they are Danish Scoreboard firms, or subsidiaries of Danish or foreign scoreboard firms. This sample has been then matched with registry data, to disentangle job mobility between firms, as well as wage growth at the individual level following a job change.

Our results show that employees of R&D intensive MNCs are less inclined to change job than other employees, and when they do move, they tend to move within the R&D intensive MNCs rather than to other firms in the economy. Working for an R&D intensive MNC may provide employees with perceived benefits deriving from their status as they tend to move less than other workers, but MNCs are also able to pay wage premia to attract possibly the most talented workers. Further analysis addressing specifically the effect of these two types of incentives for workers may provide evidence to support firms less financially endowed in attracting workers, and favour the flow of knowledge through labor mobility.

Indeed, from our analysis on SB firms, there seems to form a kind of sub labor market within the national labor market, as employees exhibit higher mobility within this group of firms than between this group and the rest of the labor market. This is bad news for the concept of labor market mobility as a channel for knowledge transfer. Indeed, knowledge transfers from foreign MNCs to the overall domestic economy can be rather weak, thus limiting their impact on the knowledge creation of the hosting country.

However, our results show that employees at foreign-owned MNCs, while not very likely to move to a domestic firm, they are much more likely to move to a domestic MNC. Hence, domestic MNCs seem to benefit from foreign MNCs labor mobility and may act as catalyser within the economy. In other words, domestic MNCs may provide ‘absorptive capacity’ and facilitate knowledge transfer by providing attractive employment opportunities for foreign MNC employees. This would imply that countries with strong domestic actors may be more able to grasp the potential benefits deriving from foreign direct investments and the presence of foreign multinational in their territory; how this interacts with the specific market labor conditions will deserve further research. We can expect that SMEs are particularly likely to be excluded from the benefits of spillovers through labor mobility from large foreign MNCs. In this respect, there might be a role for business associations and public institutions to make efforts to favor the entrance of SMEs into MNC supply chains – e.g. facilitating contacts and helping them (e.g. via standardization) to ensure that their production meets the high standards of MNCs – which could possibly enable them to enjoy higher levels of labor flows from foreign MNCs, in order to improve their knowledge stocks and technological competences.

Our analysis is not without limitations. For example, we present evidence for Denmark, and there may be concerns about whether our results are relevant for other contexts (i.e. the well-known caveat of 'external validity'). However, Denmark is a relatively small, open, and developed economy with a reasonably egalitarian wage structure, which limits the role of wages for job mobility. Hence, it is

possible that we underestimate the wage effects of job mobility compared to other countries. Another salient feature is that there is not a strong ranking of universities, such that there is no strong selection determining what university an individual attends, because educational qualifications are relatively comparable. Furthermore, because of limitations of the constituent datasets that are merged together, we focus on the period 2012-2014, and we cannot rule out that our results might be affected somewhat by the business cycle. For example, Haltiwanger et al. (2018b) show that movements from low-wage firms to high-wage firms are more common during booms than recessions. Further research on these topics would be welcome.

Overall, therefore, the evidence suggests that there are limited labor flows from (both domestic and foreign) multinationals into domestic firms hampering knowledge transfer. This has implications for FDI policy, which has previously relied on arguments that multinationals bring with them knowledge transfer though labor mobility. Future research could explore how knowledge transfer due to job mobility from multinationals could be made more effective. It could also address the role of mobility for knowledge and technology transfer from other R&D intensive organizations, for example universities (Siegel and Wright 2007; Siegel and Wessner 2012). Finally, in a broader perspective, it is important to investigate complementarities with other mechanisms for developing innovation capabilities, through a policy mix that includes supply-side (e.g. grants, subsidies, tax incentives) and demand-side (public procurement for innovation) innovation policy instruments, as well as broader policy instruments such as higher education, trade, and high-skilled immigration.

References

Agarwal, R., Gambardella, A., & Olson, D. M. (2016). Employee mobility and entrepreneurship. *Strategic Management Journal*, Virtual Special Issue 37(13), E11-E21.

Almeida, P. & Kogut, B. (1999). Localization of Knowledge and the Mobility of Engineers in Regional Networks, *Management Science*, 45(7), 905-917.

Audretsch, D.B. & Keilbach, M., (2005). The mobility of economic agents as conduits of knowledge spillovers. In *The role of labour mobility and informal networks for knowledge transfer* (pp. 8-25). Springer, Boston, MA.

Balsvik, R. (2011). Is labor mobility a channel for spillovers from multinationals? Evidence from Norwegian manufacturing. *Review of Economics and Statistics*, 93 (1), 285-297.

Camerani, R., Rotolo, D., Grassano, N., (2018). Do firms publish? A multi-sectoral analysis, *JRC Working Papers on Corporate R&D and Innovation* No 5/2018, Joint Research Centre.

Campbell, B. A., Ganco, M., Franco, A. M., & Agarwal, R. (2012). Who leaves, where to, and why worry? Employee mobility, entrepreneurship and effects on source firm performance. *Strategic Management Journal*, 33(1), 65-87.

Ciabuschi, F., Martín, O. M., & Ståhl, B. (2010). Headquarters' influence on knowledge transfer performance. *Management International Review*, 50(4), 471-491.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative science quarterly*, 35(1), 128-152.

Crespo P, & Fontoura M.P. (2007). Determinant factors of FDI Spillovers: What do we really know? *World Development* 35: 410–425

Csáfordi, Z., Lőrincz, L., Lengyel, B., & Kiss, K. M. (2020). Productivity spillovers through labor flows: productivity gap, multinational experience and industry relatedness. *Journal of Technology Transfer*, 45(1) pp.86-121

Davis, S. J., & Haltiwanger, J.C. (1991). Wage Dispersion Between and Within U.S. Manufacturing Plants, 1963–86." *Brookings Papers Econ. Activity: Microeconomics*, 115–200

Dernis, H., Gkotsis, P., Grassano, N., Nakazato, S., Squicciarini, M., van Beuzekom, B., & Vezzani, A. (2019). *World Corporate Top R&D investors: Shaping the Future of Technologies and of AI* (No. JRC117068). Joint Research Centre (Seville site).

Di Ubaldo, M., Lawless, M., & Siedschlag, I. (2018). Productivity spillovers from multinational activity to indigenous firms in Ireland. *ESRI working paper* 587.

Falck, S. (2016). Foreign-to-domestic labour mobility in Sweden. *Regional Science Policy & Practice*, 8(3), 111-125.

Görg, H. & Strobl, E., (2005). Spillovers from foreign firms through worker mobility: An empirical investigation. *Scandinavian Journal of Economics*, 107(4), pp.693-709.

Guerrero OA, Axtell RL (2013). Employment growth through labor flow networks. *PloS One*, 8 (5), 1-12

Guevara, H.H., Soriano, F.H., Tuebke, A., Vezzani, A., Dosso, M., Amoroso, S., Grassano, N., Coad, A. & Gkotsis, P. (2015). *The 2015 EU Industrial R&D Investment Scoreboard* (No. JRC98287). Joint Research Centre (Seville site).

Haltiwanger, J., Hyatt, H., & McEntarfer, E. (2018a). Who Moves Up the Job Ladder?. *Journal of Labor Economics*, 36(S1), S301-S336.

Haltiwanger, J. C., Hyatt, H. R., Kahn, L. B., & McEntarfer, E. (2018b). Cyclical job ladders by firm size and firm wage. *American Economic Journal: Macroeconomics*, 10(2), 52-85.

Hijzen, A., & Swaim, P. (2008). Do multinationals promote better pay and working conditions? The effect multinationals have on wages and working conditions can be positive, but there are conditions to bear in mind, not least for policymakers wishing to attract foreign direct investment. *OECD Observer*, (269), 15-18.

Holm, J. R., Timmermans, B., & Østergaard, C. R. (2017). The impact of multinational R&D spending firms on job polarization and mobility. JRC Technical Report, JRC108560, Luxembourg, Publications Office of the European Union. https ://doi.org/10.2760/28345 .

Hilbe, J. M. (2009). *Logistic regression models*. Chapman and hall/CRC.

Iacus, S. M., King, G., & Porro, G. (2012). Causal inference without balance checking: Coarsened exact matching. *Political Analysis*, 20(1), 1-24.

Kaiser, U., Kongsted, H. C., & Rønde, T. (2015). Does the mobility of R&D labor increase innovation?. *Journal of Economic Behavior & Organization*, 110, 91-105.

Kaiser, U., Kongsted, H. C., Laursen, K., & Ejsing, A. K. (2018). Experience matters: The role of academic scientist mobility for industrial innovation. *Strategic Management Journal*, 39(7), 1935-1958.

Lengyel, B., & Eriksson, R.H (2017). Co-worker Networks, Labour Mobility and Productivity Growth in Regions. *Journal of Economic Geography* 17(3):635-660.

Lenzi, C. (2010). Workers' mobility and patterns of knowledge diffusion: evidence from Italian data. The Journal of Technology Transfer, 35(6), 651-670.

Mincer, J. & Jovanovic, B. (1981). Labor mobility and wages. In Ed. Shervin, R. *Studies in Labor Markets*, University of Chicago Press.

Narula, R., & van der Straaten, K. (2019). A comment on the multifaceted relationship between multinational enterprises and within-country inequality (No. 035). United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Oi, W. Y., & Idson, T.L. (1999). Firm Size and Wages. *In Handbook of Labor Economics*, vol. 3B, edited by Orley Ashenfelter and David Card, 2165–2214. Amsterdam: Elsevier.

Palomeras, N. & Melero, E. (2010). Markets for Inventors: Learning-by-Hiring as a Driver of Mobility. *Management Science*, 56(5), 881-895.

Poole, J. P. (2013). Knowledge transfers from multinational to domestic firms: Evidence from worker mobility. *Review of Economics and Statistics*, 95(2), 393-406.

Rahko, J. (2017). Knowledge spillovers through inventor mobility: the effect on firm-level patenting. *The Journal of Technology Transfer*, 42(3), 585-614.

Siegel, D. S. & Wessner, C (2012). Universities and the Success of Entrepreneurial Ventures: Evidence from the Small Business Innovation Research Program. *Journal of Technology Transfer*, 37(4), 404-415.

Siegel, D. S. & Wright, M. (2007). Intellectual Property: The Assessment. *Oxford Review of Economic Policy*, 23(4), 529-540.

Sofka, W.; Preto, M. T. & de Faria, P. (2014). MNC subsidiary closures: What is the value of employees' human capital in new jobs? *Journal of International Business Studies*, 45(5), 723–750.

Song, J.; Almeida, P. & Wu, G. (2003). Learning-by-hiring: When is mobility more likely to facilitate interfirm knowledge transfer? *Management Science*, 49(4), 351-365.

Sorkin, I. (2018). Ranking firms using revealed preference. *Quarterly Journal of Economics*, 133(3), 1331-1393.

Stoyanov, A., & Zubanov, N. (2014). The distribution of the gains from spillovers through worker mobility between workers and firms. *European Economic Review*, 70, 17-35.

Weesie, J. (2000). Seemingly unrelated estimation and the cluster-adjusted sandwich estimator. Stata Technical Bulletin, 9(52). 231-248

Wright, M.; Tartari, V.; Huang, K. G.; Di Lorenzo, F. & Bercovitz, J. (2018). Knowledge worker mobility in context: Pushing the boundaries of theory and methods. *Journal of Management Studies*, 55(1), 1-26.

Table 1: R&D and Innovation Activities

	Domestic SB firms and their subsidiaries	Subsidiaries of foreign SB firms	Other private firms in Denmark
New product and/or service	61.29%	38.82%	24.49%
New process	50.00%	30.20%	25.14%
New market	54.84%	41.18%	31.09%
New organisation	64.52%	45.88%	35.50%
R&D expenditures			
Mean	35.98	2.30	0.388
P25	0	0	0
Median	2.25	0	0
P75	28.97	0.54	0
Sum	2230.60	586.53	1736.76
per 1000 FTE	27.91	7.96	3.29
per Sales	9.33	5.82	0.13
Av. Share of SB firm total international R&D expenditure	65.74%	0.53%	-

Note: R&D expenditures in millions of euro in 2013. 'per FTE' is millions per 1000 FTE and 'per Sales' is euros of R&D expenditures per millions of euros in sales.

Table 2:ISCO and Skill Level

First digit of ISCO-08	**ISCO-08 label**	**Group**		
1	Managers	High		
2	Professionals	High		
3	Technicians and Associate Professionals	High		
4	Clerical Support Workers		Middling	
5	Services and Sales Workers			Low
7	Craft and Related Trades Workers		Middling	
8	Plant and Machine Operators and Assemblers		Middling	
9	Elementary Occupations			Low

Table 3: Descriptive Statistics

	full sample n=2.530.720		CEM sample n=1.937.075	
Move to non-SB firm	0.027	0.162	0.026	0.160
Move to SB firm	0.003	0.057	0.003	0.059
Move to Foreign SB firm	0.001	0.038	0.002	0.039
Move to Domestic SB firm	0.002	0.042	0.002	0.044
wage growth	0.030	0.126	0.030	0.123
Scoreboard firm (any)	0.180	0.384	0.222	0.415
Scoreboard firm (domestic)	0.092	0.289	0.112	0.316
Scoreboard firm (foreign)	0.088	0.283	0.109	0.312
Gender	1.309	0.462	1.285	0.451
age	42.725	11.172	42.870	10.930
education (yrs.)	13.919	2.322	13.938	2.209
Experience (yrs.)	24.159	9.122	24.856	8.601
Tenure (in previous firm)	7.435	6.493	7.742	6.616
ln(hourly wage)	5.363	0.409	5.378	0.411
Occupation. High	0.409	0.492	0.415	0.493
Occupation. Middling	0.246	0.431	0.256	0.437
employment size	1988.826	5410.731	2044.165	5400.731
ln(employment size)	5.139	2.427	5.240	2.412

Table 4:Mobility Patterns of Workers

	non-move		move to non-SB firm		move to foreign SB firm		move to domestic SB firm		Total
non-SB employee	2.009.507	96.8 %	61.203	2.9 %	2.530	0.1 %	3.768	0.2 %	2.077.008
	81.9 %		90.2 %		70.4 %		82.9 %		82.1 %
SB employee	445.242	98.1 %	6.628	1.5 %	1.066	0.2 %	776	0.2 %	453.712
	18.1 %		9.8 %		29.6 %		17.1 %		17.9 %
Domestic SB employee	*227.965*	*98.7 %*	*2.606*	*1.1 %*	*276*	*0.1 %*	*124*	*0.1 %*	*230.971*
	9.3 %		*3.8 %*		*7.7 %*		*2.7 %*		*9.1 %*
Foreign SB employee	*217.277*	*97.5 %*	*4.022*	*1.8 %*	*790*	*0.4 %*	*652*	*0.3 %*	*222.741*
	8.9 %		*5.9 %*		*22.0 %*		*14.3 %*		*8.8 %*
Total	2.454.749		67.831		3.596		4.544		2.530.720

Table 5: Occupation and education

Occupation	*Subsidiaries of domestic SB firms*	*Subsidiaries of foreign SB firms*	*Other private firms in Denmark*
Managers	5.61	7.43	5.4
Professionals	36.92	20.9	18.71
Technicians and Associate Professionals	21.6	19.3	12.48
Clerical Support Workers	10.4	23.14	8.94
Services and Sales Workers	1.58	6.72	18.94
Skilled Agricultural, Forestry and Fishery Workers	0.09	0.11	1.37
Craft and Related Trades Workers	8.96	7.79	13.35
Plant and Machine Operators and Assemblers	11.04	10.34	7.45
Elementary Occupations	3.8	4.28	13.35
Education			
Primary education	11.61	17.98	25.4
Upper secondary education (General)	4.01	6.84	7.11
Upper secondary education (Specialised)	2.54	3.71	3.37
Post-secondary non-tertiary education	34.04	37.93	38.39
Short-cycle tertiary education	11.38	8.64	5.86
Professional bachelor	12.01	10.48	8.02
Academic bachelor	2.97	2.73	2.39
Master or equivalent	18.93	10.99	8.7
Doctoral or equivalent	2.52	0.69	0.75

Source: DST's registries

Table 6: Multinomial Logit Estimates for Labor Mobility

	Model 1		**Model 2**		**Model 3**		**Model 4**		
VARIABLES	Non-SB firm	SB firm	Non-SB firm	SB firm	Non-SB firm	SB firm	Non-SB firm	foreign SB firm	Domestic SB firm
CEM	no	no	sample	sample	sample	sample	sample	sample	sample
Industry, year, and region FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
SB firm (any)	-0.3067***	0.7176***	-0.2912***	0.7470***					
	(0.053)	(0.092)	(0.053)	(0.093)					
SB firm (domestic)					-0.3605***	0.7421***	-0.3604***	0.0106	0.9666***
					(0.084)	(0.152)	(0.084)	(0.260)	(0.168)
SB firm (foreign)					-0.2497***	0.7505***	-0.2497***	0.8510***	0.6328***
					(0.057)	(0.090)	(0.057)	(0.123)	(0.124)
Gender	-0.0770***	-0.0577	-0.0818***	-0.0248	-0.0820***	-0.0249	-0.0821***	-0.1315*	0.0590
	(0.020)	(0.040)	(0.021)	(0.038)	(0.021)	(0.039)	(0.021)	(0.066)	(0.046)
Age	-0.0420***	-0.0540***	-0.0447***	-0.0593***	-0.0448***	-0.0593***	-0.0448***	-0.0512***	-0.0672***
	(0.001)	(0.004)	(0.002)	(0.005)	(0.002)	(0.005)	(0.002)	(0.007)	(0.006)
Education (yrs.)	0.0083**	0.0613***	0.0057	0.0560***	0.0059	0.0561***	0.0059	0.0070	0.0941***
	(0.003)	(0.008)	(0.004)	(0.009)	(0.004)	(0.008)	(0.004)	(0.011)	(0.011)
Experience (yrs.)	0.0238***	0.0250***	0.0266***	0.0325***	0.0267***	0.0325***	0.0267***	0.0346***	0.0320***
	(0.002)	(0.004)	(0.002)	(0.006)	(0.002)	(0.006)	(0.002)	(0.008)	(0.007)
Tenure (previous firm)	-0.0449***	-0.0748***	-0.0456***	-0.0726***	-0.0454***	-0.0726***	-0.0454***	-0.0821***	-0.0640***
	(0.007)	(0.005)	(0.007)	(0.005)	(0.007)	(0.005)	(0.007)	(0.008)	(0.005)
ln(hourly wage)	0.0722*	0.5149***	0.0735*	0.4797***	0.0722*	0.4796***	0.0722*	0.5067***	0.4706***
	(0.033)	(0.048)	(0.036)	(0.049)	(0.036)	(0.049)	(0.036)	(0.076)	(0.061)
occuH	0.0535	0.4875***	0.0760+	0.5633***	0.0756+	0.5632***	0.0756+	0.6516***	0.4892***
	(0.042)	(0.066)	(0.046)	(0.064)	(0.046)	(0.063)	(0.046)	(0.080)	(0.088)
occuM	-0.0220	0.2079***	-0.0369	0.1857**	-0.0372	0.1857**	-0.0371	0.2534**	0.1304
	(0.040)	(0.058)	(0.044)	(0.066)	(0.044)	(0.066)	(0.044)	(0.085)	(0.099)
ln(employment size)	-0.0501***	-0.0180	-0.0522***	-0.0226	-0.0515***	-0.0224	-0.0515***	-0.0659***	0.0146
	(0.010)	(0.014)	(0.011)	(0.016)	(0.011)	(0.015)	(0.011)	(0.016)	(0.023)
Constant	-2.1791***	-7.1467***	-2.1293***	-6.9576***	-2.1203***	-6.9572***	-2.1203***	-7.5114***	-7.8875***
	(0.200)	(0.288)	(0.221)	(0.307)	(0.222)	(0.307)	(0.222)	(0.463)	(0.403)
Observations	2.441.517		1.905.153		1.905.153			1.905.153	
Pseudo R2	0.102		0.102		0.102			0.103	
Log Likelihood	-315339		-243470		-243463			-247227	

Robust standard errors in parentheses. *** p<0.001. ** p<0.01. * p<0.05. + p<0.1

Table 7: Robustness analysis

	Model 5		Model 6		
VARIABLES	Non-SB firm	SB firm	Non-SB firm	foreign SB firm	Domestic SB firm
CEM	sample	sample	sample	sample	sample
Industry, year, and region FE	yes	yes	yes	yes	yes
Scoreboard firm (domestic)	-0.3719***	-0.0294	-0.3719***	-0.0335	-0.0832
	(0.083)	(0.146)	(0.083)	(0.261)	(0.135)
Scoreboard firm (foreign)	-0.2536***	0.5644***	-0.2536***	0.6117***	0.5275***
	(0.057)	(0.088)	(0.057)	(0.125)	(0.107)
Gender	-0.0829***	-0.0678+	-0.0829***	-0.1432*	-0.0025
	(0.021)	(0.041)	(0.021)	(0.066)	(0.050)
age	-0.0448***	-0.0621***	-0.0448***	-0.0523***	-0.0734***
	(0.002)	(0.005)	(0.002)	(0.008)	(0.006)
education (yrs.)	0.0059	0.0648***	0.0059	0.0124	0.1094***
	(0.004)	(0.009)	(0.004)	(0.012)	(0.012)
Experience (yrs.)	0.0268***	0.0341***	0.0268***	0.0347***	0.0355***
	(0.002)	(0.006)	(0.002)	(0.008)	(0.007)
Tenure (in previous firm)	-0.0455***	-0.0741***	-0.0455***	-0.0833***	-0.0645***
	(0.007)	(0.005)	(0.007)	(0.008)	(0.006)
ln(hourly wage)	0.0716*	0.5252***	0.0717*	0.5429***	0.5248***
	(0.037)	(0.046)	(0.037)	(0.067)	(0.058)
occuH	0.0755+	0.5167***	0.0756+	0.6312***	0.4026***
	(0.046)	(0.061)	(0.046)	(0.078)	(0.083)
occuM	-0.0372	0.1162+	-0.0372	0.2076**	0.0317
	(0.044)	(0.060)	(0.044)	(0.078)	(0.088)
ln(employment size)	-0.0483***	0.0062	-0.0483***	-0.0477**	0.0559***
	(0.010)	(0.012)	(0.010)	(0.015)	(0.017)
Constant	-2.1354***	-7.1639***	-2.1354***	-7.7736***	-8.1276***
	(0.223)	(0.303)	(0.223)	(0.429)	(0.411)
Observations	1,903,387		1,903,387		
Pseudo R2	0.101		0.101		
Log Likelihood	-239734		-243245		

Notes: Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 8: Wage Growth for Mobility

VARIABLES	**Model 7**	**Model 8**
CEM	no	sample
Industry, year, and region FE	yes	yes
Move to Scoreboard firms	0.0533***	0.0541***
	(0.004)	(0.004)
Scoreboard	0.0002	0.0012
	(0.005)	(0.005)
Gender	-0.0648***	-0.0671***
	(0.003)	(0.003)
age	-0.0019***	-0.0026***
	(0.000)	(0.000)
education (yrs.)	0.0120***	0.0118***
	(0.001)	(0.001)
Experience (yrs.)	0.0033***	0.0041***
	(0.000)	(0.001)
Tenure (in previous firm)	-0.0002	-0.0001
	(0.000)	(0.000)
ln(hourly wage)	-0.4454***	-0.4446***
	(0.011)	(0.012)
occuH	0.0842***	0.0860***
	(0.006)	(0.006)
occuM	0.0201***	0.0186***
	(0.004)	(0.004)
ln size	-0.0036***	-0.0039***
	(0.001)	(0.001)
Constant	2.2669***	2.2788***
	(0.054)	(0.060)
Observations	72.501	55.567
R-squared	0.254	0.252

Notes: Robust standard errors in parentheses. *** p<0.001. ** p<0.01. * p<0.05. + p<0.1

Figure 1:Matching SB Firms and Register

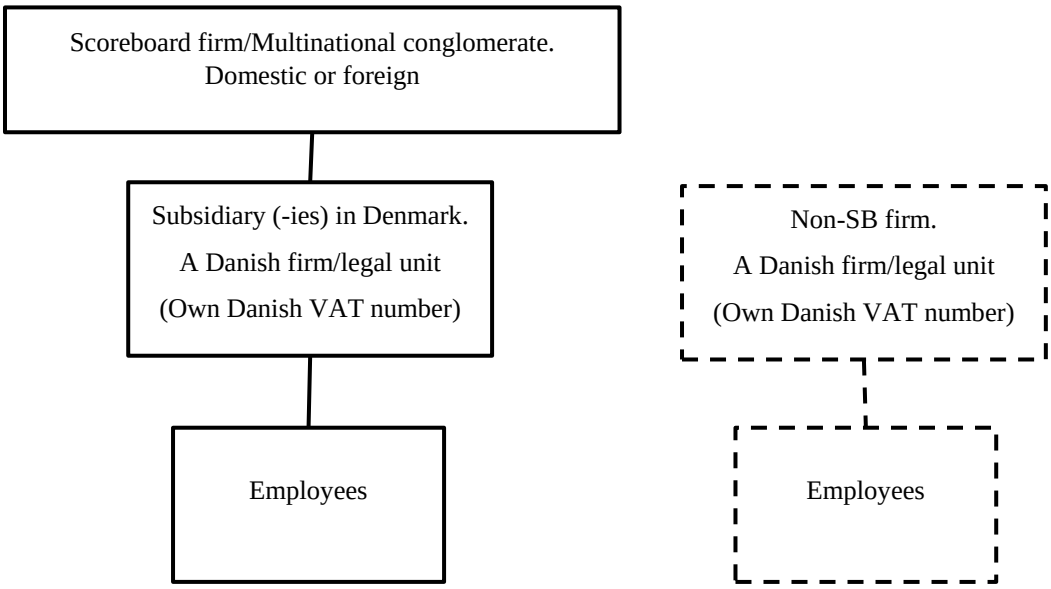
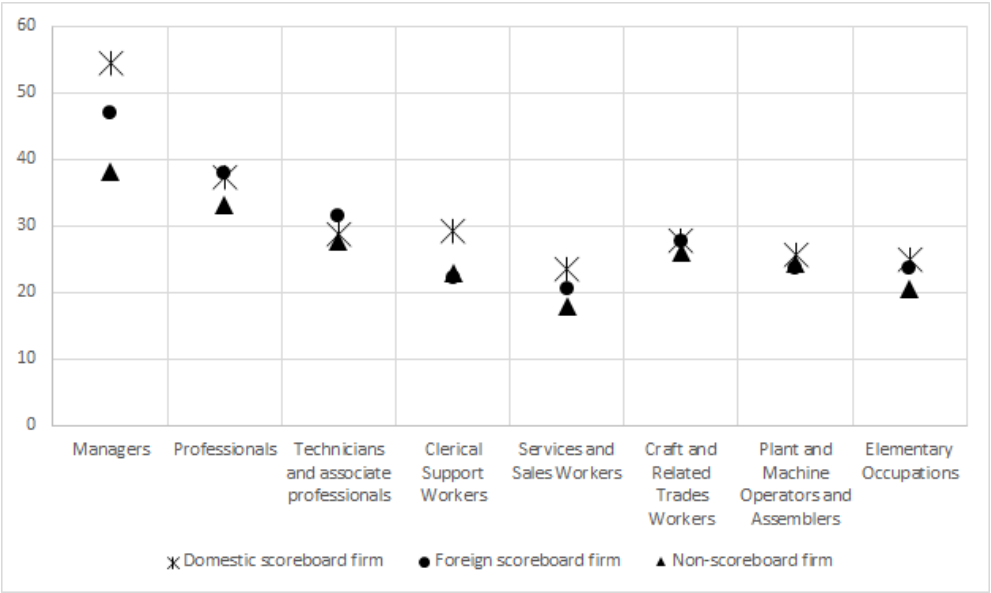


Figure 2: Median Wages across occupations and Typology of Firm



Note: Median wages in Euro/hour, average for 2012-2014

Appendix: Mobility analysis on movers

	Model A1	**Model A2**	**Model A3**	
VARIABLES	SB firm	SB firm	foreign SB firm	Domestic SB firm
CEM	sample	sample	sample	sample
industry and region FE	yes	yes	yes	yes
Scoreboard firm (any)	0.9699***			
	(0.079)			
Scoreboard firm (domestic)		1.0598***	0.4158*	1.2817***
		(0.115)	(0.183)	(0.148)
Scoreboard firm (foreign)		0.9119***	1.0084***	0.8017***
		(0.091)	(0.113)	(0.125)
Gender	0.0132	0.0122	-0.0829	0.0959+
	(0.040)	(0.040)	(0.061)	(0.051)
age	-0.0171**	-0.0170**	-0.0082	-0.0268***
	(0.005)	(0.005)	(0.008)	(0.007)
education (yrs.)	0.0642***	0.0639***	0.0133	0.1047***
	(0.009)	(0.009)	(0.012)	(0.012)
Experience (yrs.)	0.0091	0.0091	0.0088	0.0114
	(0.006)	(0.006)	(0.009)	(0.008)
Tenure (in previous firm)	-0.0143**	-0.0147**	-0.0212***	-0.0085
	(0.005)	(0.005)	(0.006)	(0.006)
ln(hourly_wage)	0.3640***	0.3680***	0.4118***	0.3492***
	(0.054)	(0.054)	(0.074)	(0.068)
occuH	0.4118***	0.4157***	0.4716***	0.3777***
	(0.058)	(0.058)	(0.078)	(0.079)
occuM	0.1352*	0.1352*	0.2219**	0.0609
	(0.064)	(0.064)	(0.086)	(0.092)
ln(employment_ size)	0.0796***	0.0757***	0.0263+	0.1165***
	(0.014)	(0.015)	(0.016)	(0.022)
Constant	-4.6820***	-4.6768***	-5.4780***	-5.4496***
	(0.315)	(0.316)	(0.446)	(0.413)
Observations	55.537	55.537	55.567	55.567
Pseudo-R2	0.143	0.143	0.145	0.145
Log Likelihood	-17194	-17190	-20966	-20966

Robust standard errors in parentheses. *** p<0.001. ** p<0.01. * p<0.05. + p<0.1